

G05DHF – NAG Fortran Library Routine Document

Note. Before using this routine, please read the Users' Note for your implementation to check the interpretation of bold italicised terms and other implementation-dependent details.

1 Purpose

G05DHF returns a pseudo-random real number taken from a χ^2 distribution with n degrees of freedom.

2 Specification

```
real FUNCTION G05DHF(N, IFAIL)
  INTEGER                N, IFAIL
```

3 Description

The distribution has PDF (probability density function)

$$f(x) = \frac{x^{(1/2)n-1} \times e^{-x/2}}{2^{(1/2)n} \times (\frac{1}{2}n - 1)!} \quad \text{if } x > 0;$$

$$f(x) = 0 \quad \text{otherwise.}$$

This is the same as a gamma distribution with parameters $\frac{1}{2}n$ and 2; the routine calls G05DGF with these parameters.

4 References

- [1] Knuth D E (1981) *The Art of Computer Programming (Volume 2)* Addison–Wesley (2nd Edition)
- [2] Kendall M G and Stuart A (1969) *The Advanced Theory of Statistics (Volume 1)* Griffin (3rd Edition)

5 Parameters

- 1: N — **INTEGER** *Input*
On entry: the number of degrees of freedom, n , of the distribution.
Constraint: $N \geq 1$.
- 2: IFAIL — **INTEGER** *Input/Output*
On entry: IFAIL must be set to 0, -1 or 1. For users not familiar with this parameter (described in Chapter P01) the recommended value is 0.
On exit: IFAIL = 0 unless the routine detects an error (see Section 6).

6 Error Indicators and Warnings

Errors detected by the routine:

IFAIL = 1

On entry, $N < 1$.

7 Accuracy

Not applicable.

8 Further Comments

The time taken by the routine increases with n .

9 Example

The example program prints the first five pseudo-random real numbers from a χ^2 distribution with 5 degrees of freedom, generated by G05DHF after initialisation by G05CBF.

9.1 Program Text

Note. The listing of the example program presented below uses bold italicised terms to denote precision-dependent details. Please read the Users' Note for your implementation to check the interpretation of these terms. As explained in the Essential Introduction to this manual, the results produced may not be identical for all implementations.

```
*      G05DHF Example Program Text
*      Mark 14 Revised.  NAG Copyright 1989.
*      .. Parameters ..
      INTEGER          NOUT
      PARAMETER        (NOUT=6)
*      .. Local Scalars ..
      real             X
      INTEGER          I, IFAIL
*      .. External Functions ..
      real             G05DHF
      EXTERNAL          G05DHF
*      .. External Subroutines ..
      EXTERNAL          G05CBF
*      .. Executable Statements ..
      WRITE (NOUT,*) 'G05DHF Example Program Results'
      WRITE (NOUT,*)
      CALL G05CBF(0)
      IFAIL = 0
      DO 20 I = 1, 5
*
*          X = G05DHF(5,IFAIL)
*
*          WRITE (NOUT,99999) X
      20 CONTINUE
      STOP
*
99999 FORMAT (1X,F10.4)
      END
```

9.2 Program Data

None.

9.3 Program Results

G05DHF Example Program Results

```
6.7995
1.6156
9.0290
2.2949
3.7902
```